Claims

1. A process for producing actinol from ketoisophorone which comprises contacting ketoisophorone with a recombinant microorganism or cell-free extract thereof in a reaction mixture, wherein said recombinant microorganism is obtainable by transforming a host microorganism, e.g. selected from the group consisting of microorganisms of the genera *Saccharomyces*, *Zygosaccharomyces*, and *Candida*, such as commercially available baker's yeast, *Saccharomyces cerevisiae* ATCC7754, *Saccharomyces rouxii* (*Zygosaccharomyces rouxii*) HUT7191 (IFO 0494), *Saccharomyces delbrueckii* HUT7116 (*Saccharomyces unisporus* IFO 0298), *Saccharomyces delbrueckii* (*Torulaspora delbrueckii*) HUT7102, *Saccharomyces willianus* HUT7106, *Zygosaccharomyces bailii* ATCC11486, *Candida tropicalis* IFO 1403, and a mutant thereof,
which is capable of reducing ketoisophorone to levodione with a levodione reductase gene, e.g. a levodione reductase gene derived from a microorganism belonging to the genus *Corynebacterium*, such as *C. aquaticum* AKU611 (FERM BP-6448) or a mutant thereof, and isolating the produced actinol from the reaction mixture.

2. The process according to claim 1, wherein the reaction is carried out at pH values of from 4.0 to 9.0, preferably from 5.0 to 8.0, and at a temperature range from 10 to 50°C, preferably from 20 to 40°C, and for 15 minutes to 72 hours, preferably for 30 minutes to 48 hours.

3. A process for producing actinol from ketoisophorone which comprises contacting ketoisophorone with a recombinant microorganism or cell-free extract thereof in a reaction mixture, wherein said recombinant microorganism is obtainable by transforming a host microorganism, e.g. selected from the group consisting of microorganisms of the genera *Cellulomonas*, *Corynebacterium*, *Planococcus*, and *Arthrobacter*, such as *Cellulomonas* sp. AKU672 (FERM BP-6449), *Corynebacterium aquaticum* AKU610 (FERM BP-6447), *C. aquaticum* AKU611 (FERM BP-6448), *P. okeanokoites* AKU152 (IFO 15880), *A. sulfureus* AKU635 (IFO 12678), and a mutant thereof, which is capable of reducing levodione to actinol with a ketoisophorone reductase gene, e.g. derived from a microorganism belonging to the genera *Saccharomyces*, *Zygosaccharomyces*, or *Candida*, such as commercially available baker's yeast, *S. cerevisiae* ATCC7754, *S. rouxii* (*Z. rouxii*) HUT7191 (IFO 0494), *S. delbrueckii* HUT7116 (*S. unisporus* IFO 0298), *S. delbrueckii* (*Torulaspora delbrueckii*) HUT7102, *S. willianus* HUT7106, *Z. bailii* ATCC11486, *C. tropicalis* IFO 1403, and a mutant thereof, and isolating the resulted actinol from the reaction mixture.

4. The process according to claim 3, wherein the reaction is carried out at pH values of from 4.0 to 9.0, preferably from 5.0 to 8.0, and at a temperature range from 10 to 50°C, preferably from 20 to 40°C, and for 15 minutes to 72 hours, preferably for 30 minutes to 48 hours.

5. A process for producing actinol from ketoisophorone which comprises contacting ketoisophorone with a recombinant microorganism or cell-free extract thereof in a reaction mixture, wherein said recombinant microorganism, e.g. selected from the group consisting of microorganisms of the genera *Cellulomonas*, *Corynebacterium*, *Planococcus*, and *Arthrobacter*, such as *Cellulomonas* sp. AKU672 (FERM BP-6449), *Corynebacterium aquaticum* AKU610 (FERM BP-6447), *C. aquaticum* AKU611 (FERM BP-6448), *P. okeanokoites* AKU152 (IFO 15880), *A. sulfureus* AKU635 (IFO 12678), and a mutant thereof, expresses both ketoisophorone reductase gene and levodione reductase gene, e.g. a levodione reductase gene derived from a microorganism belonging to the genus *Corynebacterium*, such as *C. aquaticum* AKU611 (FERM BP-6448) or a mutant thereof, and isolating the produced actinol from the reaction mixture.

6. The process according to claim 5, wherein the reaction is carried out at pH values of from 4.0 to 9.0, preferably from 5.0 to 8.0, and at a temperature in the range of from 10 to 50°C, preferably from 20 to 40°C, and for 15 minutes to 72 hours, preferably for 30 minutes to 48 hours.

7. A process for producing actinol from ketoisophorone by contacting ketoisophorone with purified ketoisophorone reductase, e.g. derived from a microorganism belonging to the genera *Saccharomyces, Zygosaccharomyces*, or *Candida*, such as commercially available baker's yeast, *S. cerevisiae* ATCC7754, *S. rouxii* (*Z. rouxii*) HUT7191 (IFO 0494), *S. delbrueckii* HUT7116 (*S. unisporus* IFO 0298), *S. delbrueckii* (*Torulaspora delbrueckii*) HUT7102, *S. willianus* HUT7106, *Z. bailii* ATCC11486, *C. tropicalis* IFO 1403, and a mutant thereof, which is capable of catalyzing the conversion of ketoisophorone to levodione and purified levodione reductase, e.g. a levodione reductase derived from a microorganism belonging to the genus *Corynebacterium*, such as *C. aquaticum* AKU611 (FERM BP-6448) or a mutant thereof, which is capable of catalyzing the conversion of levodione to actinol simultaneously.

8. The process according to claim 7, wherein the reaction is carried out at pH values of from 4.0 to 9.0, preferably from 5.0 to 8.0, at a temperature in the range of from 10 to 50°C, preferably from 20 to 40°C, and for 5 minutes to 48 hours, preferably for 15 minutes to 24 hours.

9. A recombinant microorganism that is obtainable by transforming a host organism, e.g. a microorganism belonging to the genera *Saccharomyces, Zygosaccharomyces*, or *Candida*, such as commercially available baker's yeast, *S. cerevisiae* ATCC7754, *S. rouxii* (*Z. rouxii*) HUT7191 (IFO 0494), *S. delbrueckii* HUT7116 (*S. unisporus* IFO 0298), *S. delbrueckii* (*Torulaspora delbrueckii*) HUT7102, *S. willianus* HUT7106, *Z. bailii* ATCC11486, *C. tropicalis* IFO 1403, and a mutant thereof, which is capable of reducing ketoisophorone to levodione with a levodione reductase gene, e.g. a levodione reductase gene derived from a microorganism belonging to the genus *Corynebacterium*, such as *C. aquaticum* AKU611 (FERM BP-6448) or a mutant thereof.

10. A recombinant microorganism that is obtainable by transforming a host organism, e.g. a microorganism of the genera *Cellulomonas, Corynebacterium, Planococcus*, and *Arthrobacter*, such as *Cellulomonas* sp. AKU672 (FERM BP-6449), *Corynebacterium aquaticum* AKU610 (FERM BP-6447), *C. aquaticum* AKU611 (FERM BP-6448), *P. okeanokoites* AKU152 (IFO 15880), *A. sulfureus* AKU635 (IFO 12678), and a mutant thereof, which is capable of reducing levodione to actinol with ketoisophorone reductase gene, e.g , derived from a microorganism belonging to the genera *Saccharomyces, Zygosaccharomyces*, or *Candida*, such as commercially available baker's yeast, *S. cerevisiae* ATCC7754, *S. rouxii* (*Z. rouxii*) HUT7191 (IFO 0494), *S. delbrueckii* HUT7116 (*S. unisporus* IFO 0298), *S. delbrueckii* (*Torulaspora delbrueckii*) HUT7102, *S. willianus* HUT7106, *Z. bailii* ATCC11486, *C. tropicalis* IFO 1403, and a mutant thereof.

11. A recombinant microorganism which expresses both ketoisophorone reductase gene, e.g , derived from a microorganism belonging to the genera *Saccharomyces, Zygosaccharomyces*, or *Candida*, such as commercially available baker's yeast, *S. cerevisiae* ATCC7754, *S. rouxii* (*Z. rouxii*) HUT7191 (IFO 0494), *S. delbrueckii* HUT7116 (*S. unisporus* IFO 0298), *S. delbrueckii* (*Torulaspora delbrueckii*) HUT7102, *S. willianus* HUT7106, *Z. bailii* ATCC11486, *C. tropicalis* IFO 1403, and a mutant thereof, and a levodione reductase gene, e.g. a levodione reductase gene derived from a microorganism belonging to the genus *Corynebacterium*, such as *C. aquaticum* AKU611 (FERM BP-6448) or a mutant thereof.

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